## REMARKS

Review and reconsideration on the merits are requested.

Applicants first address the rejection of claim 5 under 35 U.S.C. § 112(2) as being indefinite.

They offer the following explanation on the objected to terminology.

### The Present Invention

The metal structure of the inventive maraging steel does not contain oxide type non-metallic inclusions having a size of more than 20 μm in maximum length. Those inclusions include spinel type inclusions and alumina inclusions. Thus, all the oxide type non-metallic inclusions in the inventive steel have a size of not more than 20 μm in maximum length as defined in claim 5.

The inventive maraging steel also contains oxide type non-metallic inclusions having a size of less than 10 μm in maximum length. However, such smaller size non-metallic inclusions do not adversely affect the fatigue resistance of the steel. Thus, claim 5 defines only the oxide type non-metallic inclusions having a size of not less than 10 μm to not more than 20 μm, which inclusions adversely affect the fatigue resistance of the steel. Further, the content of other oxide non-metallic inclusions in the inventive steel, namely, other than the oxide type non-metallic inclusions (i.e., spinel type inclusions and alumina inclusions) having a size of from not less than 10 μm to not more than 20 μm is very low.

The following additional explanation is offered.

(i) The number of spinel type inclusions having a size of from not less than 10 μm to not more than 20 μm + the number of alumina inclusions having a size of from not less than 10 μm to not more than 20 μm = 100%.

(ii) The number of spinel type inclusions having a size of from not less than 10 μm to not more than 20 μm ÷ more than 33%.

(iii) The above relationship (Items 1 and 2) is expressed by the following equation:

The number of spinel type inclusions having a size of from not less than 10 μm to not more than 20 μm ÷[(the number of spinel type inclusions having a size of from not less than 10 μm to not more than 20 μm) + (the number of the alumina inclusions having a size of from not less than 10 μm to not more than 20 μm)] ÷ more than 0.33.

Applicants use the above language in Claim 5, but if the Examiner feels some other language is better, the Examiner is requested to contact the undersigned so that a telephone interview may be conducted.

**The Prior Art**

U.S. 6,663,730 Coutu (Coutu); U.S. 6,562,153 Uehara et al (Uehara); ASM Metals Handbook, 1998 (Handbook); U.S. 6,918,969 Zeze et al (Zeze); U.S. 6,776,855 Ueda et al (Ueda).

**The Rejections**

Claim 1 is rejected as obvious over Coutu in view of Uehara.

Claims 2-4 are rejected as obvious over Coutu in view of Uehara and Handbook.

Claims 5-8 are rejected as obvious over Coutu in view of Zeze and further in view of Ueda.

**Claim Amendments as Ti**

See the specification at page 10, lines 4-6 and page 19, line 27 to page 20, line 4.

The Examiner's position is set forth in detail in the Action and will not be repeated here except as necessary to an understanding of Applicants' traversal which is now presented.

**Traversal**

**Coutu**

Coutu discloses a maraging steel strip or part and a process for manufacturing a strip or a part cut out of a strip. The steel preferably comprises $12 \leq Ni \leq 24.5$ wt%, $2.5 \leq Mo \leq 12$, $4.17 \leq Co \leq 20$ wt%, $Al \leq 0.15$ wt%, $Ti \leq 0.1$ wt%, $N \leq 0.003$ wt%, $Si \leq 0.1$ wt%, $Mn \leq 0.1$ wt%, $C \leq 0.005$ wt%, $S \leq 0.001$ wt%, $P \leq 0.005$ wt%, $H \leq 0.0003$ wt%, and $0 \leq 0.001$ wt%. The steel is preferably re-melted under vacuum by the VAR (Vacuum Arc Remelting) process or in a first step is re-melted under vacuum by the VAR process or under an electrically conductive slag by the ESR (Electro Slag Remelting) process and in a second step is re-melted under vacuum by the VAR process (col. 2, lines 13-17).

The Coutu maraging steel does not contain Mg with which non-metallic inclusions are refined by the VAR. The Coutu maraging steel also does not contain Ti.

Coutu does not solve the problem which the present invention solves, i.e., how to refine non-metallic inclusions such as TiN and TiCN in a maraging steel containing not less than 0.3% Ti. Such non-metallic inclusions are a primary factor in deteriorating the fatigue resistance of the steel. In the present invention, a consumable electrode containing the additive Mg is re-melted by VAR to refine the non-metallic inclusions.

Ti is an important alloying element for improving the strength of steel but it forms nitrides (such as TiN and TiCN) or carbo-nitrides which lead to fatigue fracture. In Coutu, taking this into consideration, no Ti is added into the maraging steel in order to avoid formation

of nitrides (such as TiN and TiCN) or carbo-nitrides in the steel. Since the maraging steel of Coutu does not contain Ti, there is no reason to avoid the formation of nitrides (such as TiN and TiCN) or carbo-nitrides in the steel.

**Uehara**

Uehara discloses a working-induced martensitic type steel consisting essentially of, by mass, 0.01 to 0.10% carbon, not more than 3.0% Si, more than 5.0% but not more than 10.0% Mn, 1.0 to 12.0% Ni, 4 to 18% Cr, at least one element of 0.1 to 4.0% in total in terms of Mo + (W/2), which at least one element is selected from the group consisting of Mo and W, from zero to not more than 5.0% Cu, from zero to not more than 0.15% nitrogen, not more than 0.10% Al, not more than 0.005% oxygen, and the balance substantially Fe.

Uehara does not teach using a consumable electrode containing Mg for carrying out VAR to refine non-metallic inclusions. The steel of Uehara also does not contain Ti.

The Uehara working-induced martensitic type steel was proposed as a new high strength steel and as an alternative to maraging steels (see col. 1, lines 27-43), i.e., it is not a maraging steel containing Ti.

The Examiner reasons that Uehara teaches that the addition of Mg to steel enhances hot workability by reducing the amount of sulfur and oxygen segregated at grain boundaries. However, in the examples of Uehara, ingots are produced by vacuum melting but **no remelting is conducted**. The reason why no remelting is conducted is that in Uehara Mg is used to fix sulfur by forming a magnesium sulfide. Therefore, if the steel of Uehara were to be subjected to VAR, the Mg in the MgS would be vaporized, resulting in the Mg effect of improving the steel

in hot workability being deteriorated. Further, Uchara is quite silent on and does not suggest the behavior of MgO (produced by the additive Mg) before and after remelting.

**Metals Handbook**

Although the Handbook teaches a method of producing a maraging steel by VAR, it does not teach refining non-metallic inclusions in steel using additive Mg.

**The Combination of Coutu/Uehara/Handbook**

The prior art does not teach one to carry out VAR using a consumable electrode containing Mg to refine non-metallic inclusions. Further, the steels of Coutu and Uehara are of a type improved in strength without Ti, in direct contrast to the maraging steel of the present invention containing not less than 0.3 mass% Ti. In fact, the steel of Uehara is not a maraging type steel.

The technical idea of refining non-metallic inclusions in a maraging steel using Mg is not suggested by the combination of Coutu, Uehara and Handbook. If the steel of Uchara were to be subjected to VAR, the Mg in the MgS would be vaporized resulting in the effect of Mg in improving the steel in hot workability being deteriorated.

***Zeze***

Zeze discloses a cast steel of excellent workability.

According to Zeze, to refine crystal grains in steel, Zeze accomplishes grain-refining by adding Mg into the steel, thereby dispersing fine MgO inclusions in molten steel, the MgO becoming crystal nuclei on solidifying.

The technical idea of Zeze is primarily directed to a ferritic stainless steel containing 10 to 23 mass% Cr, not to a maraging steel containing not less than 0.3 mass% Ti. Further, Zeze relates to producing a slab by continuous casting without remelting, and thus has no relationship to the VAR process.

The particular metal structure containing oxide type non-metallic inclusions as defined in claim 5 of the present application can be obtained by subjecting a consumable electrode containing Mg to VAR. Non-metallic inclusions in the cast steel of Zeze, which steel is produced by a different process from VAR using a consumable electrode containing Mg, cannot be in a state as defined in claim 5 of the present application.

**Ueda**

Ueda discloses a maraging steel having a chemical composition consisting essentially of, in % by weight, 0.01% or less C, 8-19% Ni, 8-20% Co, 2-9% Mo, 0.1-2% Ti, 0.15% or less Al, 0.003% or less N, 0.0015% or less O, and the balance Fe.

In accordance with Ueda, in a maraging steel containing Ti, nonmetallic inclusions are refined by adjusting the shape of a mold. The adjustment is made to produce a maraging steel excellent in fatigue strength (see col. 1, lines 54-59).

The particular metal structure containing oxide type non-metallic inclusions as defined in claim 5 of the present application can be obtained by subjecting a consumable electrode containing Mg to VAR. Non-metallic inclusions in the maraging steel of Ueda, which is produced by a different process from VAR in combination with a consumable electrode containing Mg, cannot be in a state as defined in claim 5 of the present application.

AMENDMENT UNDER 37 C.F.R. §1.111
U.S. Appln. No. 10/715,568

**The Combination Coutu, Zeze and Ueda**

The concept if refining non-metallic inclusions in a maraging steel using Mg is not suggested by the combination of reference. When considering the possibility of a combination, one must note that the maraging steel of Coutu without Ti is not produced by VAR using a consulable electrode containing Mg, the invention of Zeze relates to a ferritic stainless steel produced by continuous casting, and that the maraging steel of Ueda is produced by a process different from VAR.

Withdrawal of the art rejections is requested.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

Peter D. Olexy
Registration No. 24,513

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE
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CUSTOMER NUMBER

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